TREATMENT OF TIBIAL SHAFT FRACTURES IN ADULTS BY INTRAMEDULLARY NAILING AND EARLY WEIGHT BEARING WITH P. T. B. CAST

THESIS

For

MASTER OF SURGERY

(ORTHOPAEDICS)

BUNDELKHAND UNIVERSITY
JHANSI (U. P.)

1993 **RAJESH AGRAWAL**

CERTIFICATE

Certified that the research work, entitled "TREATMENT OF TIBIAL SHAFT FRACTURES IN ADULTS BY INTRAMEDULLARY NAILING AND EARLY WEIGHT BEARING WITH P.T.B. CAST", was conducted by Dr. RAJESH AGRAWAL himself in this Deopartment. He has put in the necessary stay in this department as required by the regulation of Bundelkhand University.

21/9/92

(P.K. DABRAL)

M.S.,

PROFESSOR & HEAD

DEPARTMENT OF ORTHOPAEDICS,

M.L.B. MEDICAL COLLEGE,

JHANSI

CERTIFICATE

Certified that the research wsork, entitled "TREATMENT OF TIBIAL SHAFT FRACTURES IN ADULTS BY INTRAMEDULLARY NAILING AND EARLY WEIGHT BEARING WITH P.T.B. CAST", was conducted by Dr. RAJESH AGRAWAL under our guidance and supervision. The techniques mentioned in this work were undertaken by thc candidate himself. The resu lts and observation were checked and verified by us periodically.

(A.K. GUPTA)
M.D.,
ASSOCIATE PROFESSOR
DEPARTMENT OF RADIOLOGY
M.L.B.MEDICAL COLLEGE,
JHANSI
(CO-GUIDE)

(R.P. TRIPATHI)
M.S.,M.A.G.S,
ASSOCIATE PROFESSOR
DEPTT. OF ORTHOPAEDICS
M.L.B.MEDICAL COLLEGE,
JHANSI.
(GUIDE)

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Rajesh Agrawal

(RAJESH AGRAWAL)

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INTRODUCTION

INTRODUCTION

In the modern age of high speed traffic, industrialisation and mechanisation of life, number of accidents are increasing day by day, there by Causing various bone injuries . Fracture of the tibial shaft is one of the commonest fracture of lower extremity. As one third of its surface is subcutaneous through most of its length, compound fractures are common in the tibia than any other long bone. Further more the blood supply of the tibia is more precarious than those bones which are enclosed by thick muscles. Delayed union, non-union and infections are frequent complications in fractures of tibial shaft.

Though the fracture of tibial shaft is common, the method of choice of treatment continues to remain controversial and poses a challenge for orthopaedic surgeons. In literature many methods of treating these fractures have been advocated and there have been many analyses of the end results of such treatment but all of them have some or the other shortcomings.

On the one hand there is a view that these fractures should be treated with conservative methods. On the other there are various surgical techniques for fixation by plates, intramedullary nails and highly mechanical external fixator. The conservative treatment

by conventional toe-to groin POP cast poses the problems of prolonged immobilization, prolonged recumbency, post immobilization stiffness, osteoporosis, muscular wasting, post-plaster oedema, thromboembolic phenomenon and occasionally psychiatric manifestations. As a result patient takes 5-6 months, before he goes back to his work which adversely affects the econom of the family and the society.

The conservative surgeons like Dehne and Sarmiento (1974) have encouraged functional treatment with patellar tendon bearing (P.T.B.) cast or brace, which has become popular especially in comparison with conservative treatment with toe-to groin POP cast. The PTB cast provides support for the fracture site and lessens the load on skeletal system by converting the leg into semi-rigid hydraulic tube. On the other hand, walking in PTB cast provides uniform intermittent compressive pressure which promotes osteogenesis. Again in stable fractures it is a satisfactory method but in unstable ones it is very difficult to maintain the reduced position only by plaster cast, resulting into malunion, delayed union or non-union.

External fixation devices have enjoyed long period of enthusiastic use. They afford certain advantage owing to more rigid fixation, early

mobilization, protective care for wound without disturbing the fracture alignment or fixation and thus causing least joint stiffness, oedema, muscle atrophy and osteoporosis. The highly mechanized metallic fixation devices have some disadvantages, being costly and difficult in assembling the fixator by the uninitiated surgeon.

Open reduction and internal fixation, although results in good anatomical reduction and rigid immobilization avoiding a few of the complications of conventional closed method, yet carries a difinite risk of infection and delayed union. It disturbs the normal healing process by periosteal stripping and draining of the fracture haematoma.

The introduction of strong clover leaf nail combined with principle of reaming out the medullary canal and the development of image intensifier have revived interest in closed nailing. Lottes (1954) and Kuntscher (1958) have reported incouraging results with such technique. still this method is not in common use and is practised only in big centres because of certain limitations such as a specialised traction device and image intensifier.

If the favourable features of intramedullary nailing and functional PTB cast are amalgamated, a fruitful symbiosis will result. So in our study there is fixation of fracture shaft tibia by intramedullary nailing followed by functional PTB cast for early weight bearing in selected cases.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

The earliest reference to the subject of healing in literature, are found in ATHARAVA-VEDA (2000 BC). CHARAKA-SAMHITA (1000 BC) mentioned a medicated bandage "KAVALIKA". Sushruta (100 BC) has described the fractures as "Kanda-Bhang". Various types of fractures and dislocations are described in Sushruta Samhita. In the treatment of the fractures of lower extremities "Kapat-Shayana" (Door bed) or a fracture board consisting of a plank of wood resembling the panel of a door were used. For the fracture of the lower limb after making the patient lie on the bed, the injured limb was immobilised with the help of pegs.

Apart form these references, no clear concept of treatment of fractures particularly of lower limb was available till the middle of 18th century. Hippocrates was the first to study the effect of muscle spasm on fractures which caused shortening and over riding. Hence splinting the limb to overcome these problems became popular in the middle of 18th century.

Turkish Empire(1798) reported that the setting of bones, were practiced by enclosing the broken bones in case of plasterof paris .lates onin 1852.Adonius Mathysen a Flemish Army surgeon popularised the use of plaster of paris bandages. The limbs were to be immobilised with one joint proximal and one distal till complete union occured.

The first external fixation for the treatment of fractures was described by Molgaigne (1851). Parkhill (1897) described the use of two half pins above and two half pins below the fracture in long bone, externally joined by an indegenous clamp for fracture reduction and immobilisation.

The technique of walking cast was first developed by Krause (1891) and later by Dollinger and Budapest (1893).They used to apply the unpadded plaster to treat fracture of leg, so that weight might be transmitted from tuberosity of tibia to bottom of plaster.

Lembotte (1913); Grooves (1918) and Rush and Rush (1937) used some forms of nail for intramedullary fixation of tibial fractures.

Oskar Linden (1938) Observed in a study of 52 cases treated by conventional method, the average healing time was 22.3 weeks. The average shortening was one to two cm with five to ten degree of valgus deformity in 38.4 percent and varus deformity in twenty five percent cases.

Raoul Hoffmann of Switzerland (1938) developed a four plaster double frame external fixation device. He presented a series of articles describing his method of external fixation from 1938 to 1954.

Gurd (1940) described early weight bearing for the treatment of tibial shaft fractures, advantages and disadvantages of different methods and the unfavourable features from patients points of view.

Griffith (1942) analysed 249 cases of fractures of both bone in the patients treated by closed method of reduction with above Knee plaster of paris cast. The mean time for union was 16.5 weeks and eight cases had non-union.

Robert funstein (1945) reviewed 149 cases of fracture of both bones leg and found average healing time to be 11.2 weeks for clinical union and 30.4 weeks for radiological union. Types of fractures made practically no difference in the rate of healing.

Eggers et al (1949) demonstrated the effect of contact compression factor on the osteogenesis in surgical fractures. They described two forces acting at the fracture sites, the internal force exerted by the mass of the muscle especially in the voluntary contraction and external contact compression exerted by gravity and weight bearing. They concluded that :

1. Presence of contact compression factor stimulates the osteogenesis.

2. Excessive compression fails to stimulate osteogenesis.

Lottes (1952) evaluated the results of 176 fractures of the tibial shaft treated by nailing, plating and plaster immobilisation. The average healing time was six months, 11.8 and 8.4 months respectively. Incidence of non union was 23.7 percent with plating, 10 percent with conservative treatment and none with nailing. As regards the deformity, there was varus or valgus angulation of three degree or more in 19.6 percent cases of conservative treatment, 5.7 percent in closed nailing and 4.3 percent in plate fixation. For the three groups shortening of over 6 cm was in 19.6 percent, 1.9 percent and 4.3 percent of the cases in that order.

Carpenter et al (1952) and Jackson (1959) concluded that 95 percent of tibial shaft fractures, whether simple, comminuted or compound can be adequately managed by closed reduction with the advantage that such conservative means will avoid serious complications and will enable the fractures to heal in a shorter period than a similar fracture treated by open reduction and internal fixation. Their conclusion is that initial haematoma around a fracture contains osteogenic properties which help in healing of the fracture. If this haematoma is exposed to external environment by open reduction, not only the union of fracture is delayed but also chances of infection increases.

Lottes (1954) reported 300 cases of tibial shaft fractures treated by the closed intramedullary nailing He used Lottes nail. It was necessary to expose the fracture site in only three out of 300 cases all in fresh fractures, because of failure to obtain reduction by closed method. In fresh fractures of tibia with intact fibula, the fibula was osteotomized after the nailing has been completed to allow impaction and weight bearing .

Wade and Campbell (1958) reported discouraging results with the use of plates as compared to other form of surgery. According to them endosteum appeared to assume the sole responsibility for binding the fracture site, but fixed distraction and excess of foreign material made the use of plates hazardous.

Ellis (1958) treated 315 fractures conservatively and recorded average healing time as 10, 15 and 23 weeks for minor severity. moderate severity and major severity of fractures respectively.

Kuntscher (1958) used the improved nail and his method gained popularity. Introduction of strong intramedullary nail combined with the principle of reaming out the medullazry canal and the development of image intensifier have recovered interest in closed nailing.

Solheim (1960) studied 500 tibial shaft fractures treated by either closed reduction and plaster of paris cast or open reduction and internal fixation. He found that healing time was shortest with conservative method and that the transverse fractures united earlier..

Dehne et al; (1961) treated fractured tibia by immobilisation in a near skin tight cast with knee held in full extension and with immediate weight bearing. The average time of healing and return to work for all 207 patients was five months. In 86 percent of the patients the time for healing and mobilisation was between four and six months. In remaining 14 percent cases it varied from two to four months.

Alder et al (1962) reported that osteomyelitis developed in twenty percent cases of open fracture treated by medullary nailing and only in 2.2 percent of similar fractures treated without internal fixation. They also stated that Kuntscher nailing cannot be used in comminuted fractures and also in patients below fourteen years of age, because of fear of epiphyseal demage.

Alms (1962) treated a total of 50 fractures of tibial shaft by closed intramedullary nailing for which

no external splint was used and the patient allowed to walk as soon as the wound healed. The average period of absence from work for the patient was eleven weeks. There was no case of sepsis or non union.

Nicoll (1964) in his survey of 705 cases of fresh tibial shaft fractures of which 674 were treated conservatively and 31 were treated by primary intramedullary nailing or plating. He observed the average time of union of fracture was 16 weeks (12 to 20 Weeks). Incidence of delayed and non union in infected cases was 60 percent. Intact fibula showed to hasten the process of healing. Twenty five percent of cases had foot and ankle stiffness. In his opinion "Internal fixation actually delays unioin unless it is absolutely rigid and this is never the case with intramedullary nailing". But internal fixation can be justified on grounds that it reduced the incidence of functionally significant deformity and joint stiffness, it significantly lowered the incidence of delayed and non-union.

Caladias (1964) and Dankwardtt (1969) described that the nutrient artery is destroyed and endosteum and bone marrow is almost completely removed because of reaming and nailing and so more chances of delayed or non union. Endosteal callus formation is scarce. There are chances of fat embolism follwoing reaming of tibia.

Edward (1965) treated 492 fractures with closed reduction and plaster application. The results after one year were analysed as good, fair and poor. Longitudinal fractures showed 85 percent good, 15 percent fair while the transverse fractures showed 95 percent good, five percent poor results. Union time was nine months in closed tranverse fractures and fourteen months in open transverse fractures. Complications such as skin necrosis, osteomyelitis and malunion were observed in four cases.

Muller et al (1965) treated tibial shaft fracture by compression plates. They reported encouraging results with dynamic compression plates and reported 93 percent results as good whereas only six percent complication rate was found in closed group treated fracture of tibia.

Weissman and Herold (1966) treated tibial shaft fracture without internal fixation in 150 cases and found that the average time of union was four months and seventeen days along with average time of hospitalization of seven days. Temporary limitations of movements at knee and ankle was observed in most patients during first few months after plaster was removed. shortening of leg amounting to 3", 2" , 1½" and 1" respectively was observed in four cases and one case had varus angulation of 30 degrees. Seven patients had pain over the fracture site for more than seven months.

Anderson et al (1966) reported their experience with a method of closed treatment of fractures of tibia and fibula. They used steinmann pin through the tibia and closed reduction followed by plaster application. They found certain advantages of this method over closed reduction in cases of unstable fractures of both bones of leg. In only 2.1 percent, union was delayed and in 1.9 percent no union developed out of 128 fractures of the tibia and fibula treated by the above method.

Augusto Sarmiento (1967) advocated the idea that the tibial fractures could easily be managed with the help of below the knee weight bearing cast in total contact, permitting the movements at knee joint. He submitted a report of 100 cases of fracture shaft tibia, who were treated by conventional toe-to-groin cast followed by patellar tendon bearing cast, which was given within six weeks of injury. The average healing time was 14.5 weeks. 78% of all fractures were associated with fracture of fibula, had healing time 13.1 weeks and 22% were associated with intact fibula, had healing time of 15.6 weeks.

Zuckman and Maurer (1969) reported 36 cases of two level fractures of tibia treated by blind nailing of which 17 patients had closed fractures. Primary bone union in good position were obtained in 15 cases and aseptic union was found in 0.2 percent. No case had

malunion, union with sepsis or septic nonunion. They concluded that both the fractures upper and lower had the same potential for union. In these cases walking was started with full weight bearing in an average time of three to four months and it decreases the rate of non union and infection as compared with other type of fixation devices.

Brown and Urban (1969) presented a series of 60 cases of fractures shaft tibia. After reduction a long leg cast was applied and early weight bearing was permitted. They reported 100 percent union with average period of nineteen weeks. The overall shortening was 9 mm. , angulation was less than ten degrees.

Sermeinto (1970) treated 135 cases of fracture shaft tibia by a functional below knee brace and stated that the patient walked with full weight bearing after four weeks of injury. Average healing time was 14.1 weeks in both bone fracture leg and 16.8 weeks when fibula was intact. Average amount of shortening observed was 6.4 mm.No rotation deformity was recognised at follow up but the ultimate degree of rotation of distal fragment was not measured accurately. Several minor pressure sores were encountered in the popliteal fossa.

Birotte and Joseph (1970) treated 75 fresh displaced fractures of tibia by percutaneous multiple pin fixation, short leg cast and immediate weight

bearing reviewed 100 percent healing with an average period of healing between 16 to 20 weeks. They used four pins two in proximal and two in distal fragments but segmental and comminuted fractures needed five or six pins. The mean time for healing was eighteen and half weeks. oblique fractures healed slowly. There were no instances of non union or delayed union. Secondary, inflammatory reaction in about two pins occurred. Preserved knee motion was associated with early restored ankle and foot motion.

Hamza et al (1971) reported 50 patients with fracture tibia - 28 closed and 22 open treated by intramedullary nailing. Nineteen patients had closed nailing and remaining underwent open nailing. Average time for clinical union was three months. Radiological union was obtained at an average of four months. Average time interval between injury and return to work was 4.5 months. Patients who had developed non union during treatment by other nethod can obtain union expeditiously after reaming and inserting large size nail.

Burwell (1971) treated 181 cases of fracture shaft tibia by plate fixation and concluded that closed method of treatment is considered to be the safest method.

Gamble et al (1972) treated 100 fractures of tibia by early weight bearing in long leg cast and

evaluated the result close to Brown (1974). Brown concluded that the closed reduction and early weight bearing in long leg cast often concedes minor complication in favour of a predictably high union rate with no major complications and can be used for all types of tibial shaft fractures.

Denis King (1972) submitted his report and said about the original use of below the knee cast in total contact, based on P.T.B. prosthesis. He gave much stress on moulding over medial flare of tibia, popliteal fossa and patellar tendon. P.T.B. cast was given within 5 weeks of injury, following toe-to groin cast. The average time of plaster was 4-5 weeks less in P.T.B. cast and all patients returned to their work 2 months earlier than those treated in toe-to-groin cast. No mal-union, delayed union or non union has been reported.

Olerud and Karlstrom (1972) did secondary intramedullary nailing of tibial fractures. They took thirteen patients who had already been treated with compression plating but due to poor compression achieved they underwent secondary intramedullary nailing after reaming of medullary canal; with regard stability delayed intramedullary nailing has an important advantage namely the endosteal callus which gives nail a firm grip in fracture of lower and upper end to tibia. Out of 13 cases only one had infection which

considerably delayed the healing of fracture. The final results were excellent or good in 87 percent of cases.

Berkin and Mershal (1972) used three sided plate fixation for fractures of tibia. Two plates which were slotted fenestrated and gutter shaped were placed such that its linear margin would be in contact of bone on two sides and an Egger's slotted plate placed along the third side. This assembly did not results into angulation. Ninety two tibial fractures were treated with above method. The overall results were very good in 72 cases, 11 were good and nine were satisfactory. There were six post operative wound infection. Delayed union occured in 11 patients.

Dunn et al (1973) in their study of 45 closed tibial shaft fractures, treated by P.T.B. cast reported average healing time of 14.1 weeks. Non union occurred in two cases.

Protzman and Burkhaltor (1974) reviewed 440 fractured tibia, 228 open and 212 closed. Open fractures were treated by debridement and toe-to-groin cast with early weight bearing. In 159 of open fractures, both fragments were exposed at fracture site due to soft tissue loss. The average time for removal of plaster cast was 20 weeks for closed and 21 weeks for open fractures and 23 weeks for exposed fractures.

Sarmeinto et al (1974) studied the stability effect of interosseous membrane and soft tissue on tibial shaft fractures treated in below the knee total contact cast. The effect of interosseous membrane were analysed in cadaver and freshly amputated limbs, using morphological, histological and dynamic testing techniques. Effects of soft tissue were demonstrated using a transparent brace with a gel substituted for soft tissue.

Smith (1974) compared the results of early and delayed internal fixation in the treatment of fractures shaft of tibia. He observed that average healing time was 26 weeks in cases of early internal fixation and eighteen weeks in delayed internal fixation. He thus confirmed that in except mild fractures early internal fixation would always increase the time of healing and incidence of complications.

Krengel and Romano (1975) reported 59 adults with 60 tibial fractures treated initially by closed reduction and immobilisation in above knee cast, replaced by a weight bearing P.T.B. cast following 21 days. 5 percent angulation and 50% percent loss of apposition were the maximum malalignment accepted. Non union occured in 5 percent of cases, all of them were displaced fractures in distal third. The average shortening was 4 mm and was never more than that seen on

initial X-ray. No symptomatic loss of ankle and knee motion occurred and there was minimal muscle wasting.

Weidmer et al (1975), Fristchy and Burdet (1977) Suman (1977), Dommisse (1978) and Mollan and Brandley (1978) also applied the P.T.B. cast within 6 weeks of date of injury and compared the results with conventional treatment for fractures of tibia. The results were found superior to conventional method.

Karlstrom and Olerud (1975) treated 28 severe, open tibial fractures with stable external frame fixation by the vidal Adrey double frame method. The average time of limb kept in the frame was 4.9 moths and then a P.T.B. cast was used. The mean time until full weight bearing without external support was 7.9 months.

Newton et al (1978) also treated the fractures of tibia in age froup of 7-16 years with functional cast brace. The average healing time was 13.2 weeks. Two cases had refracture. No patient had restriction of knee and ankle movements.

Trivedi and Patel (1978) used the method of insertion of stienmann pins and incorporating them in a below knee total contact cast in 80 cases of fracture tibia and compared the results with above knee casts. The results showed that the average duration of plaster immobilisation was about same in both the series i.e.

4.2 months in below knee method and 4.5 months in above knee method. The occurrence of delayed union and failure rate were slightly lower in former method. The only complication was pin tract infection and loosening of the pin. Early ambulation with full range of movements at knee minimised the quadriceps wasting.

Sharma et al (1978) treated 45 cases of fracture shaft tibia by intramedullary 'V' nainling. Clinical union was evident by ten to fifteen weeks. Complications developed like deep wound infection in 17.2 percent and bending of nail in 7.4 percent. Patient was allowed to walk with the help of crutches after removal of stitches and was allowed to walk with weight bearing after 6 weeks. The hospital stay was from 11 to 20 days.

Clancey et al (1978) treated 102 open tibial shaft fractures, 56 with cast immobilisation , 35 with internal fixation and seven with external fixatioln. Average time of healing was 19.5, 19 and 28 weeks respectively. Deep infection developed more in cases with internal fixation (11 percent) than in cases treated with cast immobilisation.

Sharma et al (1979) studied 258 fractures of tibia treated in below knee cast following toe-to-groin conventional treatment. The average time for union was 15 weeks. The fractures with intact fibula healed earlier than fractures of both bone leg.

Edward et al (1979) reported the study of 44 open tibial fractures. Seventy three percent of cases had bone loss or major comminution. After intial debridement double frame Hoffmann apparatus was applied and fracture reduced. Initial union was evident at four months, complete at seven months. Thirty percent of cases developed pin tract infection which cleared off after removal of pins.

Linden and Larson (1979) in a randomized trial of 100 transplacedfractures treated conservatively or by A.O. plating , found that complications in the A.O. group were more common. Their stay in the hospital was more, delayed union more frequent, but A.O. group healed faster with average time of 12 weeks as compared to the conservative group where healing time was 17 weeks whereas open fractures healed faster when treated conservatively.

Bhargava and Sethi (1981) treated 85 fractures of tibia with below the knee cast following a toe-to-groin cast of an average 2 weeks. During this time, weight bearing on crutches were encouraged. P.T.B. cast was given in manner described by Sarmiento (1967) with few modifications:

i) The cast was extended upto proximal pole of patella to prevent bunching of patellar tendon, when patients knee extended after full flexion.

ii) A wooden log was applied to improve toe-to-heal gait.

The results were found to be encouraging and reported average clinical union 13.7 weeks, radiological union 15.8 weeks. The average shortening was 1.1 cm. The knee had good range of movement after 3 months with average flexion 110° and no extension lack.

Groose Kempf (1982) used interlocking tibial nail which have holes through their proximal and distal ends and are used for fractures of proximal or distal third of tibia, segmental fractures and fractures with signigicant comminution.

Traditional half frames are safe and provide excellent wound access but are not rigid enough to hold unstable fractures to deal with heavy limbs, or to permit early weight bearing (Schmidt and Roreback , 1983). They reported loss of reduction in 15 percent of their cases.

Transfixation of ankle and foot dorsiflexors more distally may lead to permanent ankle stiffness. Emerson and Grabies (1983) followed up tibial fractures immobilized with bilateral frames and found that the most frequent complain was ankle and foot stiffness. Apart from neurovascular injuries and permanent joint stiffness pin tract infection have been the most serious

limiting factor in the use of traditional unitateral or bilateral frames.

Mayer et al (1985) treated 51 severe fractures of the tibial shaft with multiple intramedullary Enders nail. Forty one fractures united in less than four months and eight within four to eight months. Only two were not united even after eight months.

Lawrence and Kenneth (1986) treated 112 fractures of the tibia by manipulation reduction, reaming of medullary canal and fixation of fragments with an intramedullary nail either ASIF/AO or interlocking nail. Follow up evaluation was performed in 100 fractures. The average time of union of fracture was 19 weeks. Two patients had delayed union. Deep sepsis developed in seven percent and superficial in two percent.

Rao and Shahne (1986) treated 103 tibial shaft fractures by closed intramedullary V nailing without image intensifier. Patients were allowed to bear full weight in patellar tendon bearing cast. By twelve weeks 91 fractures had united while at 18 weeks only three had non union. Four patients needed re-operation for sequestrectomy and delayed union.

Mohindra and Nath (1987) treated 36 cases of fresh open fracture shaft tibia with direct current stimulation. They concluded that the increase in current strength did not alter the rate of fracture union. There

was only a marginal improvement in the rate of union, following electric stimulation as compared to the treatment by a P.T.B. cast alone.

Oni et al (1988) treated 100 cases of closed tibial shaft fractures by closed methods. They observed that by 20 weeks 19 fractures had not united, but 15 of these had united by 30 weeks with conservative treatment alone. The remaining four cases were operated upon because no further progress in healing was anticipated. They concluded that open reduction and internal fixation is rarely justified, in closed adult tibial shaft fractures with regard to healing.

Vengsarkar and Laud (1990) treated 54 tibial shaft fracture with functional cast brancing. They observed extremely satisfactory results from different pointsof view with an union rate of 96 percent .

Sanjay and Misurya (1990) treated 50 open fractures of tibial shaft by transverse pin fixation, combined with below knee plaster cast and early weight bearing. Union was observed in all fractures after 10-22 weeks (average 16 weeks).

Alho et al (1990) treated 93 tibial shaft fractures with Grosse-Kempf locked nail. Half of fractures were united radiologically by 15 weeks. The 26 fractures which remained statically locked, and were not

dynamised, healed in an average of 16 weeks, while those with dynamic locking healed in 14 weeks.

Hooper et al (1991) treated 62 tibial shaft fractures conservatively or by closed nailing and concluded that intramedullary nailing gave more rapid union with less mal union and shortening.

MATERIAL AND METHOD

MATERIAL AND METHODS

The present study was carried out on 15 cases of tibial shaft fractures treated with intramedullary nailing followed by early weight bearing with P.T.B. cast, carried out in the department of orthopaedics M.L.B. Medical College, Hospital, Jhansi from Dec. 90 to March, 92. All the cases were in age group 18 to 47 years.

The following cases of tibial shaft fracture were excluded from the study.

1. Children.
2. Compound injury except grade I type.
3. Associated injuries which prevented early mobilization.
4. Type of fracture : a. Gross comminution.
   b. To near to either ends of bone
   c. Long oblique and long spiral fracture.
5. Injury more than 3 weeks old.

Management of fractures :

All the suitable fractures were managed according to following plan.

1. First aid management of patient
2. Pre-operative evaluation of patient
3. Date collection and recording.
4. Intramedullay nailing.
   a. Apparatus and instrument.

b. Pre-operative assessment of size of nail.

c. Operative procedure.

d. Post operative care.

5. P.T.B. cast application followed by weight bearing .

6. Follow up.

1. First aid Management of the patient :

As soon as the patient was admitted to the hospital, he was given first aid management in the form of plaster of paris above knee slab along with analgesics and anti-inflammatory drugs.

2. Pre-operative evaluation of patient :

Cases who were fit for nailing underwent following pre-operative evaluation :-

A. General assessment.

a. General condition.

b. Pulse

c. Blood pressure.

d. Examination of other systems.

B. Local condition of skin at and away from fracture site.

C. Radiological examination for the type and site of fracture.

D. Investigations - Routine and specific.

3. Date collection and recording :

After the pre-operative evaluation, date were collected and recorded as follows :

Case No.

Name of the patient Age/Sex

Address D.O.A.

Occupation Date of injury

Brief history :

Mode of injury : Fall/Road side accident/Industrial accident.

Any other associated injury

Normal limb length :

Fracture

Side : Right/Left/Bilateral

Site : Junction of proximal and middle one third/middle one third/juction of middle and distal one third).

Nature : Simple/Grade I/Punctured).

Bone involved : Tibia/both bone.

Type : Transverse/oblique/spiral/comminuted).

Date of first aid management :

4. Intramedullary Nailing of Tibia :

A. Apparatus and Instrument :

Apart from the general set of instruments, following instruments were also required.

1. Calibrated metal ruler.
2. Kuntscher nail gauge.
3. Kuntscher clover leaf nails of various size.
4. Femoral bone Awl.
5. Guide wires.
6. Kuntscher nail impactor.
7. Mallet.
8. K. Nail extractor with hook.
9. Hack saw.
10. Straight chisels and gauges.

B. Pre-operative assessment of size of nail :

Length :

During rediological examination, calibrated metal ruler was strapped by the side of the limb parallel to the bone, in such a way that its shadow would not super imposed upon that of underlying bone and the magnification of the ruler would be same as that of the bone. In antero-posterior view ruler was strapped laterally and in lateral view anteriorly or posteriorly. By seeing the X-ray required length of the nail could be readily calculated.

Diameter of nail :

During radiological examination, kuntscher nail gauge was placed by the side of limb in such a way to give the same magnification of medullary canal as that

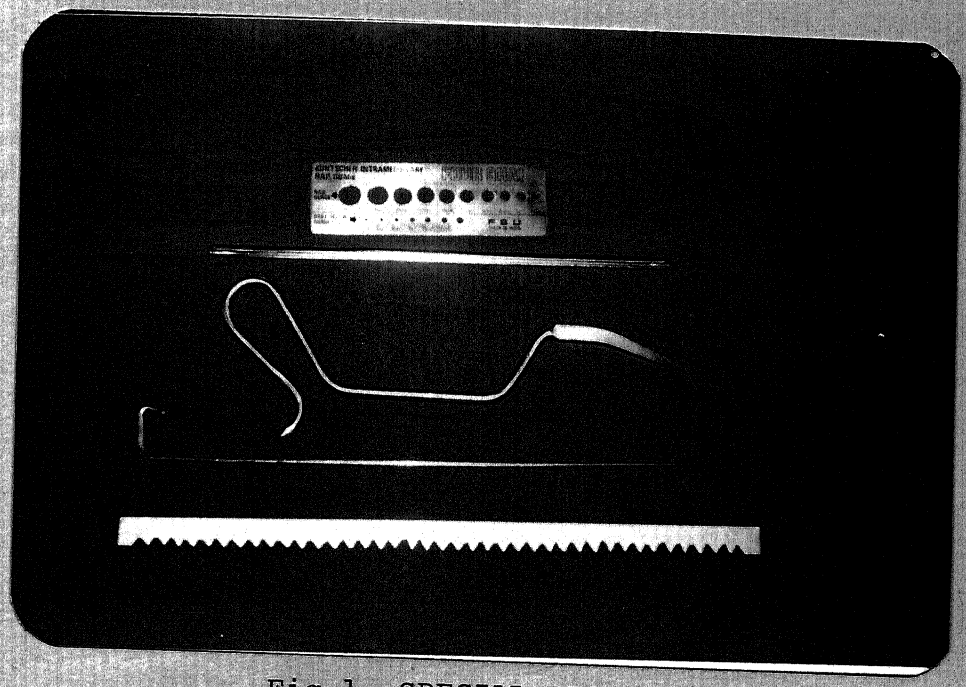


Fig 1. SPECIAL REQUIRED INSTRUMENTS.

1. Kuntscher Nail Gauge.
2. Kuntscher CloverLeaf Nail
3. Femoral Bone Awl.
4. Guide Wire
5. Calibrated Metal Ruler

of calibrated holes. The holes were matched with the narrowest diameter of medullary canal on roentgenogram to give the required diameter of nail.

C. OPERATIVE PROCEDURE:

After appropriate anaesthesia, the patient was laid supine on the operation table. The part was painted and drapped from lower thigh to just above the ankle.

Knee was flexed to about 135 degrees. About two centimeters long vertical incision was given just medial to the ligamentum patellae. The retropatellar pad of fat was exposed and the deep infrapatellar bursa opened taking care not to open the knee joint.

A femoral awl was passed through the skin incision and displacing ligamentum patellae laterally, and striking the tibial plateau over anterior end of intercondylar ridge, about two centimeter behind the anterior border to tibia. This site is extra articular. Awl was thrust further along the long axis of proximal fragment of tibia thus making the pilot track for the guide wire.

Guide wire was passed down the pilot track just short of the fracture site. Then reduction was achieved by closed manipulation and if failed then by open method.

For closed manipulation limb was allowed to

suspend vertically down by the side of the table with the knee resting at the edge. For open reduction small skin incision was given at the fracture site, just lateraland parallel to anterior border of tibia and then skin and subcutaneous tissue was incised to reach the fracture site. Fracture was reduced under vision by manipulation without disturbing the periosteum.

Guide wire was passed further by the assistant to engage the medullary canal of the distal fragment. Knee was again flexed at 135 degrees. Kuntscher clover leaf nail of appropriate size threaded over the guide wire and hammered inside taking care of patella and second toe to lie in the same line.

Guide wire was withdrawn and wound was stitched back in single layer and dressed. Wound at fracture site was also stitched in two layers and dressed in cases of open reduction.

Long leg above knee plaster of paris slab was applied.

D. POST OPERATIVE CARE

Post operative X-rays were taken and if there was any distraction, it was corrected at the earliest by applying punches at the heel with an assistant giving counter pressure by holding the knee. Sutures were removed after 10-14 days.

5. P.T.B. CAST APPLICATION FOLLOWED BY WEIGHT BEARING

Just after removal of stitches, P.T.B. cast was applied and from the next day assisted weight bearing was started with P.T.B. cast. Unassisted weight bearing became passible within one week.

Technique of P.T.B. Cast application :

Patient was asked to sit on the edge of table, hanging the affected leg vertically with hip and knee flexed at 90 degree. A stockinette was applied from toe to 2 inches above the proximal pole of patella. A thin layer of cotton was kept on the tendoachillis region. Plaster of paris bandages were wrapped from toe to above ankle region directly over the stockinette and moulding was done over both the malleoli. The cast was extended upto just below the tibial tuberosity, achieving the firm moulding over anterior tibial surface, lateral peroneal muscle mass and posterior aspect of leg. Before the plaster completely dried, it was extended up to proximal pole of patella, while knee was held in 45 degrees of flexion by an assistant. Moulding was done over medial flare of tibia, patellar tendon and popliteal fossa. A rubber heel was applied beneath the sole in the line of tibia.

G. FOLLOW UP

The patients were re-examined clinically and radiologically at the interval of 4 weeks.

In each follow up following things were looked for:

1. Condition of P.T.B. cast for its loosening and breakage.
2. Range of movements at knee and ankle joints.
3. Roentgenograms of leg in antero-posterior and lateral views to confirm alignment and callus formation.
4. Tenderness at fracture site.

All relevant data regarding treatment, post operative care and follow up were filed and tabulated in the following way so as to reach the final results.

TREATMENT Record :

Date of operation.

Type of operation : Closed/open K. Nailing.

Length and diameter of nail.

Post-operative findings :

Condition of wound scar : healthy linear scar/ unhealthy.

Date of revmoval of stitches

Radiological findings.

Date of application of P.T.B. cast

Date of starting assisted weight bearing.

Date of starting unassisted weight bearing.

Date of discharge.

FOLLOW UP RECORD : At the interval of 4 weeks from the date of nailing.

Date of unassisted unprotected weight bearing

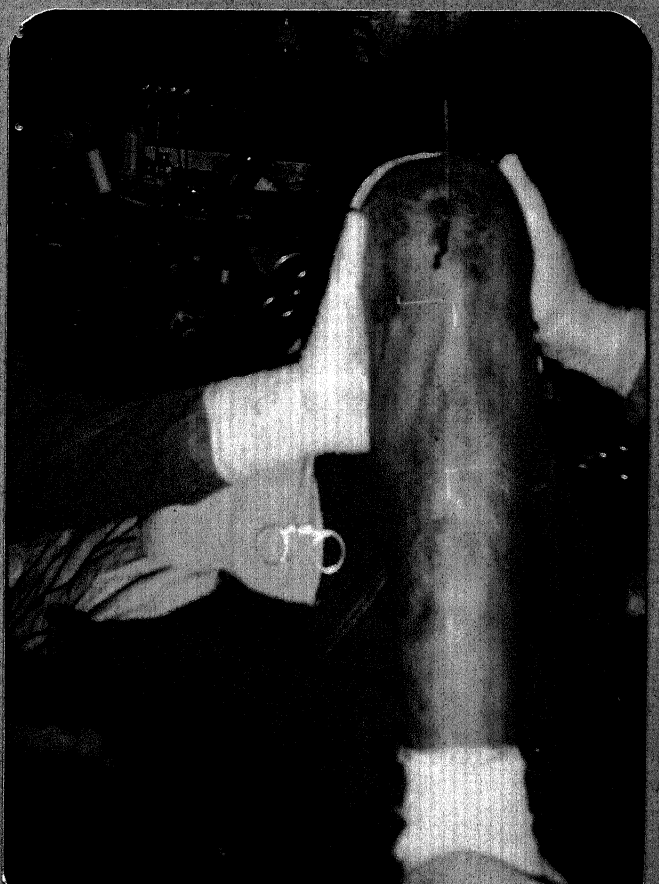
Period of return to employment (weeks) :
(In cases of working patients)

Limb length :

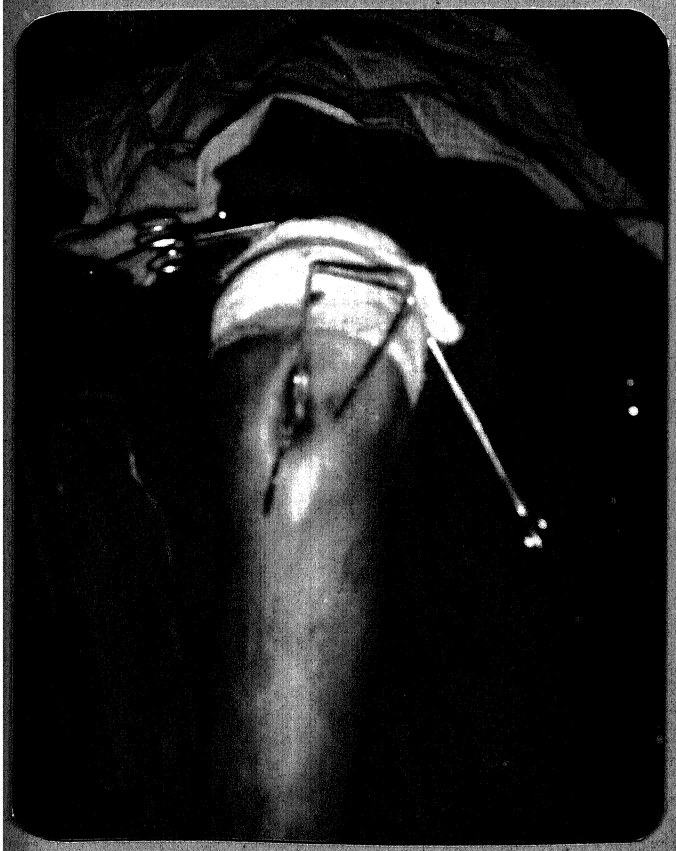
TECHNIQUE OF TIBIAL NAILING

Fig.2(A) Part Painted And Drapped.

(B) GuideWire Has Passed Through Tibial Plateau To Engage Distal Fragment, After Making Pilot Track.



TECHNIQUE OF TIBIAL NAILING



(C) K-Nail Hammered Home.

(D) Wound Closed.

OBSERVATION

OBSERVATIONS

In the present study total of 15 cases of recent fracture tibia were treated by intramedullary nailing followed by early weight bearing with PTB cast in the department of Orthopaedics, M.L.B. Medical College, Hospital , Jhansi.

Age Incidence :

Age of the patients varied from 18 to 45 years. Maximum number of cases (80 percent) belonged to age ranging from 18 to 37 years. Agewise distribution of the patients is shown in table I.

TABLE I: Showing the distribution of cases according to their age.

Age groups (years)	No.of cases	Percentage
18-27	8	53%
28-37	4	27%
38-47	3	20%
TOTAL	15	100

Sex Incidence :

Out of 15 cases, 14 (93 percent) cases were male and remaining 1 case was female(Table II)

TABLE II : Showsing the distribution of cases according to sex.

Sex	No.of cases	Percentage
Male	14	93%
Female	1	7%
TOTAL	15	100

Occupation of the patients

According to the occupation, patients were divided into light workers (House wives, students, servicemen) and heavy workers (farmers and labourers). Out of 15 cases, 9 were light workers and 6 were heavy workers (Table III).

TABLE III : Distribution of cases according to their work/occupation.

OCCUPATION	No.of cases	Percentage
Light workers	9	60%
Heavy workers	6	40%
TOTAL	15	100

Mode of injury :

In 11 cases the mode of injury was a road side accident while in 4 cases it was fall injary(Table IV).

TABLE IV : Showing the distribution of cases according to mode of injury.

MOde of injury	No. of cases	Percentage
Road side accident	11	73%
Fall from a height	4	27%
TOTAL	15	100

Side involved :

Out of 15 cases, 8 cases had fracture of right tibia and 7 had fracture of left tibia (Table v)

TABLE V : Showing the distribution of cases according to side involved in fracture.

Side involved	No.of cases	Percentage
Right	8	53%
Left	7	47%
TOTAL	15	100

Condition of fibula

Out of 15 cases 13 patients had associated fracture of fibula of the same side while 2 patients had intact fibula (Table VI).

TABLE VI: Distribution of cases according to condition of fibula.

Condition of fibula	No.of cases	Percentage
Fractured	13	87%
Intact	2	13%
TOTAL	15	100

Level of fracture :

Most (60 percent) of cases had fracture at the junction of middle and distal one third, followed by the fracture of middle on third(33%) , minimum cases were at proximal one third shaft tibia .(Table VII.

Fig.4(A)Preoperative Skiagram

Along with K-Nail Gauge

(B) 4 Weeks After Nailing

(C) 8 Weeks After Nailing

(D) 16 Weeks After Nailing

DISCUSSION

DISCUSSION

The dynamicity of the life is increasing with the advancement of civilization and so does the rate of accidents day by day. The fractures of tibial shaft have long been considered difficult problem. Still the ideal treatment of such fractures has been a matter of controversy. The conventional method of above knee immobilization in plaster cast has many complications such as :

1. Increased time of hospitalisation, convalescence or both.
2. Stiffness of the joint and decrease range of joint movement.
3. Increased rate of nonunion, delayed union and malunion.

The surgical method of open reduction and internal fixation with plate, is better alternative But has certain disadvantages and complications such as:

1. Vascularization of fractured area is impaired as periosteum is further damaged, which may result in deficient nutrition of osteogenic cells and subsequent delayed union and nonunion.
2. Increased rate of infection.
3. It inflicts surgical trauma.

The intramedullary nailing of fracture shaft tibia followed by early weight bearing with P.T.B. cast is an more acceptable method. The nailing may be closed or open depending upon case but when open, it is without or least damaging to periosteum thereby preserving vascular supply.

It has certain advantages such as :

1. It inflicts minimal surgical trauma.
2. Sub periosteal blood supply is not further disturbed.
3. Chances of infection are minimal.
4. Short hospital stay.
5. Low incidence of nonunion, delayed union and malunion.

In cases of open nailing fracture reduction was visiable through incision but in cases of closed nailing we have to rely upon the clinical judgment of fracture reduction, positioning of guide wire and ultimately of the nail. In only one case the nail failed to pass in the distal fragment as the fracture stability was misjudged because of intact fibula. In was later discovered on X-ray and corrected in the next sitting.

The maximum number of cases (53%) ranged between 18 to 27 years of age and males (93%) outnumbered females (7%) which should be due to their more active outdoor life making them more prone to trauma.

Majority of the cases had fracture at junction of middle and distal one third of tibia (60%) followed by the fracture of middle one third of tibia (33%) and the least number of cases (7%) had fracture at junction of upper and middle third.

This low incidence is probably because of more soft tissue covering of bone in upper part than in middle and lower region. Tibia being subcutaneous in most of the lenght, had high incidence of open (Grade I) fractures (40) then any other long bone.

Comminuted (40%) and oblique (27 percent) fractures were more commonly seen in our study which may be because of the position of tibia between two hinge joints so that twisting forces make it more vulnerable to the above type of fractures.

Lottes et al (1952) in his series of 216 tibial shaft fractures treated 102 cases by closed nailing and rest by plating or conservative method. They introduced the nail from the prespinal surface of the tibial plateau keeping the leg horizontal. The same position of limb was used by lottes (1954), Alms (1962); Zuckman and Maurer (1969); Hamza et al (1971) ; and Smith (1974). In all our patients the site of introduction of nail was the same as above but we kept the limb acutely flexed to about 135° while introducing the guide wire and about right angle, suspended by the side of table while

achieving reduction and negotiating the guide wire in the distal fragment. The knee was again flexed to about 135° making the leg almost vertical and placing the sole over the operation table while the nail was threaded over the guide wire and hammered home.

Lottes et al (1952) used Lotte's triflanged nail without using any guide wire. Alms, Zuckman and Maurer (1969) and Hamza et al (1971) used Kuntscher clover leaf nail bent 10 to 20 degree anteriorly near the upper end for easier extraction. In all of our cases we used Kuntscher clover leaf nail. The tip of the guide wire was made blunt so that it may not perforate the posterior cortex of proximal tibial fragment and moreover the soft tissues and vessels after the guide wire had passed through the proximal fragment but had not found its way in the distal one.

Lottes et al (1952), Zuckman and Maurer (1969) and Hamza et al (1971) did not ream the medullary canal for fear of geopardising the blood supply. Alms (1962) reamed the medullary canal as a routine before seating nail hence in his series, in most of the cases 11 mm diameter nail was accepted. We did not ream the medullary canal so in 9 cases (60%) 9 mm diameter nail was passed while in 4 cases (27 percent) 10 mm diameter nail was introduced.

In our study of 15 cases one case (7 percent) had failed closed reduction as the fibula was intact and because of pre-existing partial stability of the limb it was difficult to know clinically whether the guide wire and the nail were correctly placed. Post-operative x-ray revealed the nail lying in the soft tissue. Eventually open nailing had to be done in this case.

In one case distracttion at the fracture site occurred after nailing. Retrospectively this could be attributed to oversized nail-diameter wise. Under intravenous effect of pentothal sodium firm punches were given over the heel with counter pressure given by the assistant over the knee. The check X-ray showed good apposition of the fragments.

Operative time for successful closed nailing ranged from 20 minutes to a maximum of 50 minutes at an average of 36 minutes. The maximum time of 50 minutes was taken in three cases in which open nailing was done after an interval of 2 weeks ofm injury. The time of 36 minutes on an average is much less than the time taken for any surgery in which open reduction and internal fixation is done hence nailing has an advantage of having shorter time of exposure to the surgical trauma.

Average hospital stay in the series of Lottes et al (1952) was 1.2 months.Whereas it was three to four weeks in the series of Hamza et al (1971).In our series

54 percent of cases had an hospital stay of four weeks, while 5 (33%) cases had hospital stay of 3 weeks and two cases had stay of two weeks. Increased period of hospitalization in these cases was because we gave time for blisters or punctured wound to heal.

Lottes (1954) reported an incidence of 3.3 percent deaths occurring within a week of operation, 2.1 percent deep infection and 2.1 percent non union in a series of 254 patients. Smith studied 219 fractures of tibial shaft treated by open reduction and internal fixation and found delayed union occurring in 48 percent and infection in 20 percent. Burwell (1971) reported that 181 fractures of the tibia treated with open reduction and internal fixation using urns or venable plates had a non union rate of 4.4 percent, an infection rate of 6.6 percent. Berkin and Marshall (1972) fixed three sided plates in 92 tibial fractures which resulted in 3 deaths, 6 infection and eleven delayed union. In our study two cases (13%)had superficial wound infection which were healed in due course of time. No case had deep infection or nonunion.

Lottes et al (1952) recorded an angular deformity (Three degree or more) in 5.7 percent cases and a shortening (six mm or more) in 1.9 percent cases. They had no case of rotational deformity. Weissmen and Herold (1966) treated couservatively and found shortening amounting to 3", 2" , 1 ½" and 1"

respectively in four out of 150 cases. Sarmiento (1970) treated 135 cases of fracture shaft tibia by a functional below knee brace and found an average shortening of about 6.4 mm with no rotational deformity seen. Dehne et al (1961) reported average shortening of 0.9 cm . Nicoll (1964) reported shortening of more than 2 cm in 2.5 percent of his cases treated by conservative methods. In the present series we had two cases who had shortening of one cm. No case had angulation and rotational deformity.

Nicoll (1964) reported ankle stiffness long after union had occurred in 25 percent of his cases. Weisman et al (1966) observed temporary limitation of movements in the knee and ankle in most of the patients during the first few months after plaster was removed, Joseph (1974) found frequent possibilities of knee and ankel stiffness with above knee cast. Emerson and Grabies (1983) followed up tibial fractures immobilised with bilateral frames and found that the most frequent complaint was ankle and foot stiffness. We had no case who had any limitation of ankle or knee stiffness because while tapping down the nail we threaded on the guide wire another kuntscher nail of similar diameter as the one being introduced. This greatly facilitated the seating of nail without trouble. It was because of this improvisation that we were able to sink the upper end of the nail a few millimeters in the tibial plateau without inflicting any soft tissue and bony trauma which

went a long way in restoring full range of knee extension post-operatively.

In the present study soon after nailing long leg dorsal slab was given. after the removal of stitches, PTB cast was applied and patients were allowed to walk in PTB cast, initially with the help of stick or walker, later unassisted. Average duration for assisted protected weight bearing was 2 weeks and for unassisted protected weight bearing it was 2.5 weeks. Unprotected unassisted weight bearing was started at an average of 10 weeks which is much earlier than in the series of Lottes et al (1952) and Lottes (1954). Lottes et al (1952) allowed full weight bearing in cast at an average of 1.5 months and unprotected unassisted weight bearing was resumed on an average five months after injury.

Due to the presence of nail in the medullary canal it was difficult to judge the progress of union clinically as the stability at the fracuture site was achieved soon after successful nailing was done. criteria of absence of pain at the fracture site, good muscle tone and resumption of unassisted weight bearing were certain features to judge the progress of union. Radiologically start of formation of bridging callus and partial obliteration of fracture line were other criteria to consider the rate of union.

In our study average period of start of bridging callus formation and partial obliteration of fracture line were four weeks and eight weeks respectively.

Absence of pain at the fracture site was reported to be four weeks on an average. Unprotected unassisted (full weight bearing) was 10 weeks. In patients where early weight bearing was started resulted into minimal periosteal callus and early obliteration of fracture site.

Osker Lindon reported average healing time as 22.3 weeks in patients treated conservatively.Robert Funstein (1945) reported average healing time to be 11.2 weeks for clinical union and 30.4 weeks for radiological union. Average time of union of fracture was 16 weeks according to the study done by Nicoll (1964) in his survey of 705 cases treated conservatively.

Karlstrom and Olerud (1975) treated tibial fracture with stable external frame fixator. The average time for full weight bearing without external support was 7.9 months. Dehne (1961) treated fracture tibia by immobilization in a near skin tight cast with knee in full extension and in these cases average healing and mobilisation was within four to six months.

Vandor Lindon and Larson (1979) reported average time of healing in fractures treated by plate and screw as 12 weeks as compared to conservative treatment where the healing time was found to be 17 weeks.

Out of 15 patients of successful nailing 13 were working men who returned to their work at an average interval of 9 weeks. The early return to work could be attributed to early weight bearing, restoration of joint movements and consequently,also to early freacture union.

On the other hand conservative menthod of above knee cast immobilization, not only prevents early ambulation but also delays return to work. Michael Alms (1962) found an average period of 11 weeks and 22 weeks in patients treated by closed nailing and above knee plaster cast respectively. Slatis (1967) noted that 90 percent of his cases of fracture leg treated by long leg cast could resume work by 12 months.

Follow up varied from 51 weeks to 5 weeks. No case was lost to follow up. Patients reported faithfully whenever called to the hospital.

Out of 15 cases nine underwent closed nailing and six open nailing. No post operative complications was found in any patient except superficial infection in 13% cases and two patients had shortening of limb by one cm. Excellent results were found in 73 percent whereas good in 27 percent of our clinical study.

The technique of nailing which had been done by the workers before, had been simplified by us, as in this no costly instru ments or apparatus were used and we could get 100 percent healing with good alignment of fragments, absence of infection, early ambulation and rapid return to work. We believe that due to the simplicity of the technique it can be brought into practice even at a small centre by a person with some experience related to the subject mentioned above.

CONCLUSION

CONCLUSIONS

The present study "Treatment of tibial shaft fracture in adults by intramedullary nailing and early weight bearing with P.T.B. Cast " was conducted in the department of Orthopaedics, M.L.B. Medical College, Hospital, Jhansi. A total number of 15 cases were taken in this study. The results were evaluated and compared with the results of other methods of treatment of fracture tibia.

We concluded certain out standing advantages such as :

1. The technique is easy, safe and well acceptable by the patients without the possible complication of surgery and conventional above knee cast method.
2. The technique does not require highly sophisticated theatres and equipments, so it is most suitable in countries like ours where facilities are lacking in rural areas.
3. Periosteal supply is not disrupted.
4. Infection is low or practically nill.
5. Duration of hospital stay is low incomparison to any other method.
6. With rigid fixation early weight bearing can safely be advocated without fear of loss of reduction, shortening, angulation or rotation.
7. Healing time is less, as early mobilisation, stimulates osteosynthesis.

On the basis of present study the recovery of normal function and union with good results in majority of cases indicate that it is a good method to practise even at smaller centres for the treatment of fracture shaft tibia in the selected patients who have passed the stage of skeletal maturity.

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